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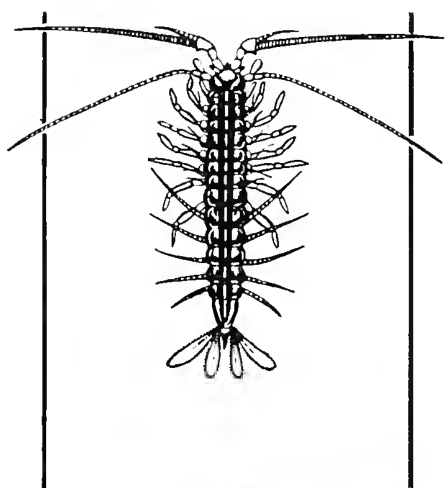

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NOTES ON THE GEOLOGY AND GEOMORPHOLOGY OF ALBATROSS ISLAND

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(With one text figure and two plates)

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ABSTRACT

Albatross Island, off northwestern Tasmania, is composed of a dipping succession of siliceous, haematitic conglomerate and minor quartz sandstone, possibly about 145m thick. It is probably correlative with similar conglomeratic successions along the northernmost part of the western coast of Tasmania, successions which are thought in turn to be correlates of the Upper Precambrian Forest Conglomerate east of Smithton.

The apparently flattish top of the island and old sea tunnel caves at about 20m above sea level probably reflect high sea-level stands during the Last Interglacial.
Key words: conglomerate, Precambrian, sea tunnels, high sea-level stands, Last Interglacial, Tasmania.

INTRODUCTION

George Bass landed on Albatross Island in 1797 but made no recorded geological observations (Flinder 1814: ch.xxii). Freycinet in the schooner "Casuarina" and Baudin stood off Albatross Island in December 1802 and described it as "un énorme rocher granitique" (an enormous granitic rock) (Peron & Freycinet 1816:25, Cornell 1974:453). A more accurate identification of the rock type was recorded by Ashworth and Le Souef (1895:138) when they noted the presence of conglomerate, "probabably Palaeozoic" but their other geological ideas were naive. The frontispiece of the "Victorian Naturalist", Volume 13 of 1896 shows an albatross on a nest with recognisable coarse conglomerate in the background. Some details of the elevated sea caves were given by Macdonald and Green (1963:24) who suggested formation at higher sea level.

Somewhat more details of the succession were provided by F.L. Sutherland (in Green 1974) who, from photographs and specimens provided by R. H. Green, noted that the conglomerate was siliceous and included fragments of quartzite and slate and that the succession included minor sandstone bands. Sutherland further noted the resemblance to Cambrian and Ordovician conglomerates of western Tasmania.

Mr. Nigel Brothers, Department of Lands, Parks and Wildlife, Tasmania, showed me specimens of sandstone (UTGD 70447-48) and coloured photographs of the island and rocks thereon in 1986. The close resemblance to the Denison Group conglomerates (Upper Cambrian and Lower Ordovician) of western Tasmania and the possibility of younger ages together with the geographic position of the outcrop suggested that a visit to seek fossils might be worthwhile. A short visit to the island early in March 1988 was made possible through the good offices of Mr. Brothers. All of two days and part of a third were spent examining the rocks from the northern end to just south of the middle gulch.

ALBATROSS ISLAND — GEOLOGY AND GEOMORPHOLOGY

Albatross Island is just over a kilometre long and up to 225m across (fig. 1) with a maximum height above sea-level of about 38m (R.A.N. Hyd. Service AUS790). It is elongated a little east of north (about 17°) and lies at 144°39'E. 40°22'S.

THE SUCCESSION

The predominant rock type, forming more than 95% of the succession, is a clast-supported siliceous conglomerate. Siliceous sandstone forms the rest of the succession.

The conglomerate consists of clasts (Plate 1B) of quartzite of several grainsizes from almost glassy to medium sand grade, vein quartz and siltstone (argillite). The quartzites are predominantly pale but some are banded red and white with bands from just over a mm to a couple of cm thick. Other clast types include bedded quartzite with cross-bedding, quartzite veined with quartz, quartzite with thin, flat, micaceous bodies (?originally clay pellets), quartzite breccia cemented by quartz and siliceous conglomerate. The predominant siltstone clasts are banded red and white, the bands a few mm wide, but some red and some medium to dark grey siltstones also occur. The matrix is predominantly quartz. The conglomerate is red, partly because of the red siltstone clasts, but mainly because of the haematitic film on the clasts and a haematitic component in the cement which is siliceous.

The clasts in the conglomerate are up to at least 0.6 metres maximum dimension and in many beds the modal grainsize is of the order of 0.1m. Most of the conglomerates would have modes within the cobble grade and few if any pebble or granule conglomerates were seen. Sorting of the conglomerate is moderate, the sand matrix having been trapped in the interstices between the larger clasts. Rounding of clasts varies according to grainsize and composition. The coarser clasts are sub-angular to angular if composed of siltstone and more rarely rounded, but sub-rounded to rounded, and rarely sub-angular or well-rounded if siliceous. The sphericity of the clasts is medium to high with the a:c axis ratio usually no more than 1.5 or 2:1 and mainly about 1:1. The conglomerate occurs in beds up to at least 10m thick and generally several metres thick. Within the limits of the outcrops seen they seem to be close to parallel-sided. Some beds give the impression of having coarse cross-bedding, but where closer examination was possible this appearance proved to be due to imbrication (Plate 1C). The imbrication in most places indicates currents flowing east, but in one place near the northern end of the island a west-flowing current seemed to be indicated.

The succession is very predominantly composed of the red, siliceous conglomerate described above with red quartz arenite as a minor component. A few sections visually estimated suggest a conglomerate-sandstone ratio of about 30:1.

In the field the sandstones appear to be quartz-rich and are red, because of a haematitic component both as clasts and in the cement. Thin sections (Plate 2) show the sandstones to be predominantly quartz, with some clasts of quartzite, bedded siliceous siltstone (Plate 2F) and haematitic clasts including haematitic quartzite, haematitic, micaceous siltstone and almost pure massive haematite. Some quartzite fragments contain rounded quartz grains with one or more generations of quartz overgrowth and quartz grains with rutile needles. Yet other grains have intersecting lines of inclusions (Plate 2E). Some quartz grains in the clasts have euhedral to almost euhedral inclusion of greenish/brownish tourmaline. The above types of quartz occur not only in the quartzite clasts but as individual grains. Much of the quartz shows undulose extinction and some shows faint, indefinite multiple twinning (plate 2E). Large grains of muscovite and/or leached biotite occur rarely in the matrix and may be clastic. Heavy minerals are very rare, much less than one percent of the rock and are mainly greenish/brownish tourmaline with one or two grains of zircon. The matrix consists essentially of quartz and well-crystallised sericite (Plate 2B,C,D,), with some crystalline haematite and many crystals or aggregates of a clear highly birefringent mineral honey yellow in polarised reflected light (probably leucoxene or sphene). Veins cutting through the rocks are either mainly sericite with some sphene or are quartz. Sandstones studied in thin section have isolated rounded clasts up to 30mm long

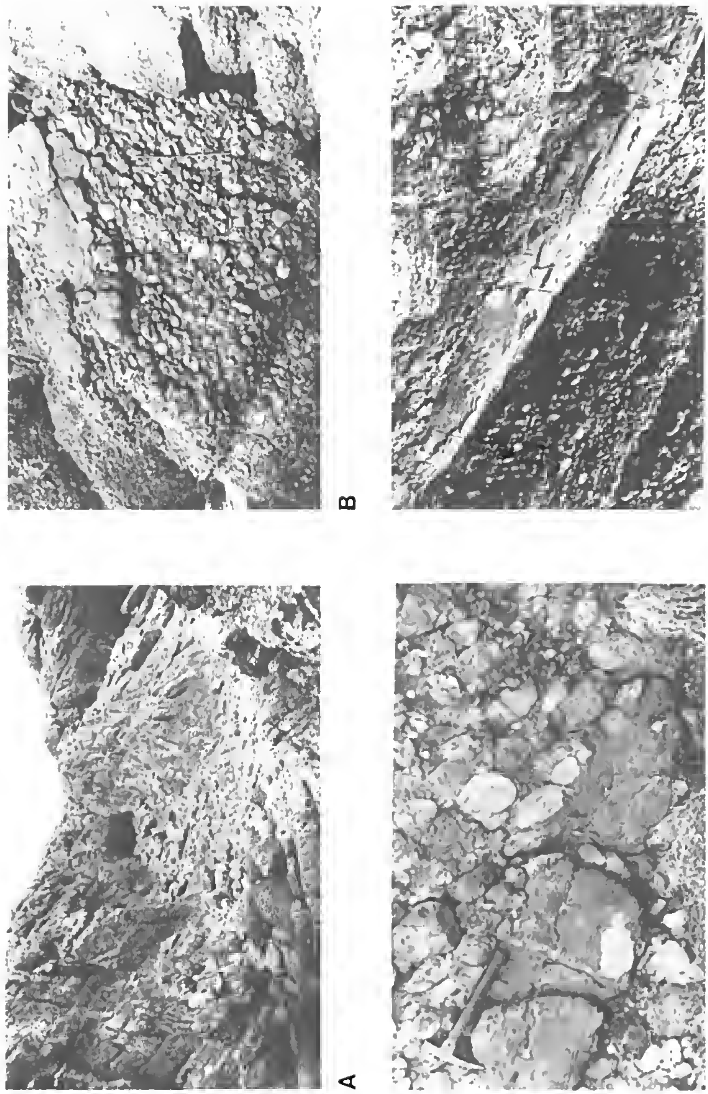

Plate 1

A. View of northern end of central tunnel cave showing westerly dip of conglomerate-beds, steep joints, topographic depression above the cave; the movement zone defining the eastern side of the cave and the east dipping fault zone which defines the position of the western side of the cave; the floor of the northern gulch may be seen in the foreground.

B. A bedding surface in a loose block of conglomerate with some sandstone attached to it; the walking stick is 1.5m long.

C. View of a face of conglomerate resting on sandstone (looking south) showing imbrication in the conglomerate.

D. A lenticular sandstone body in conglomerate (looking south).

in medium to coarse sand with a patchily distributed matrix of very fine sand to coarse silt. The amount of matrix varies from almost none to a little over 30% (Plates 2B) so that in places the rock is a quartz wacke. The larger clasts vary from well-rounded (quartzite, haematitic quartzite) to sub-angular (siltstone, haematitic siltstone, haematite), the same range in roundness being shown by the individual quartz grains. Most of the single quartz grains are almost equidimensional, but the larger clasts especially the siltstones are slightly (a:c = 1.5) to moderately (a:c = 3) elongated. In one thin section (UTGD 70448) seen at low power there is a slight preferred orientation of elongate grains and this orientation is parallel to the sericite-filled veins, suggesting that these latter show movement parallel to bedding. The elongation and the veins are also parallel to the main contact between matrix-free rock and rock with matrix this contact probably being bedding. Shearing of the rock is slight, the fabric being almost isotropic. Those parts of the rock with little matrix show sutured grain boundaries (Plates 2C) between quartz grains, the contacts in many places being moulded around sericite grains (Plate 2D) elongated perpendicular to the grain boundaries. The sandstones form beds up to about a metre thick but most are only about 0.25m thick. The base of the beds is commonly irregular on a minor scale, the sand filling depression between the clasts at the top of the underlying conglomerate bed. The tops of the beds are commonly planar. The sandstone beds appear to be lenticular (Plate 1D) both down-dip and along strike, persisting for no more than 10m down dip and even less along strike. Some interdigitation with conglomerate occurs. Cross-bedding is common in the sandstones and is mainly of the trough or festoon type although some torrential cross-bedding was observed. Components of dip of cross-bedding from the west, the south and the east were noted, the suggestion being of currents predominantly from the south-west.

From the studies made it seems that the the source area for both the conglomerates and the sandstones included quartzite derived from pre-existing sedimentary and metamorphic rocks, some of the quartzite being haematitic, some with quartz veins, siltstones including haematitic varieties, the haematite varying from less than 10% of the siltstone to over 90%, and probably some haematite bodies.

ENVIRONMENT OF DEPOSITION

Rounding of the clasts, imbrication and cross-bedding show aqueous transport and deposition and the direction of imbrication and cross-bedding suggest transport mainly from the south-west. The high conglomerate: sandstone ratio suggests a near-source origin, a suggestion borne out by the presence of angular siltstone clasts. Deposition as an alluvial fan seems highly likely, and such an environment would readily explain the red colour of both conglomerate and sandstone, indicative of oxidising conditions at the time of or subsequent to deposition.

The stream or streams building the alluvial fan drained an area of pre-existing sedimentary and low-rank metamorphic rocks of sedimentary origin, traversed in part at least by quartz veins, and of haematite bodies. The presence and angularity of the siltstone clasts suggests that the siltstone source was close to the site of deposition, the rounding of the siliceous clasts that they had been transported from rather further away.

The size of the clasts in the conglomerate indicates the presence of streams of high stream power, due either to high gradient or high water volume or both.

On the balance of the evidence available Albatross Island was, at some time in the past, the site of an alluvial fan at the foot of a rugged hill or mountain area to the west or south west.

THICKNESS

The rocks across the widest part of the island are extremely similar and can be regarded as belonging to the one formation. The dip is 36° at the widest part of the island. Using this value, the width of the island and the dip and position of the fault, the minimum thickness is calculable at 145m. No top or bottom is known.

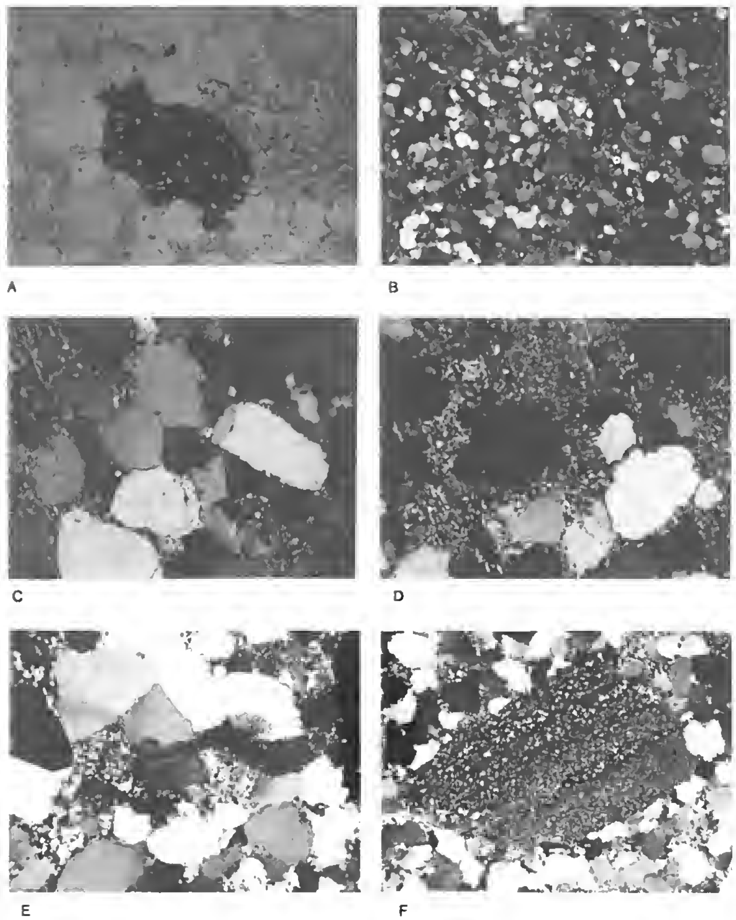

Plate 2.

Photomicrographs of thin-sections of sandstones, Albatross Island — A is with ordinary transmitted light, B to F with polarised light; A-E in specimen UTGD 70448, F in specimen UTGD 70956.

A. Haematitic siltstone clast (light patches in haematite are quartz and sericite); x75.

B. Contact (oblique, top left to bottom right) between well-sorted sandstone (bottom left) and sandstone with quartz and sericite matrix; some preferred orientation of quartz clasts subparallel to the contact may be seen; x15.

C. Sutured boundaries between quartz grains; quartz-sericite matrix; several quartz grains show authigenic overgrowths on previously rounded grains; some sericite development perpendicular to quartz clast boundaries; x75.

D. Quartz clasts in matrix of quartz and sericite; some sericite crystals moulded by quartz; x75.

E. Quartz grains with lines of inclusions, quartz grains with authigenic overgrowths; multiply twinned quartz; x75.

F. Bedded, sericite siltstone clast; x37.5.

AGE AND GEOLOGICAL RELATIONSHIP

The age of the deposit is unknown. Because of its structure it is unlikely to be as young as Late Carboniferous. The only fossils found in it were some indistinct trace fossils in a few clasts in the conglomerate. The rock is not highly sheared or metamorphosed so that it is unlikely to be as old as the metamorphosed Precambrian of Tasmania. An age within the limits Late Proterozoic to Carboniferous is probable.

Other occurrences of similar rocks may provide an indication of age, an indication that needs to be treated with caution. The nearest similar rocks were found by Mr. Bruce McQuitty just south of West Point near Marrawah in 1982. The second point south of West Point (CQ 002637) consists of north-dipping conglomerate and sandstone resting with angular unconformity on a gently-folded red bed succession. The basal beds of the conglomerate contain quartzite clasts up to 1.5m long and clasts of the underlying reddish and greenish siltstones up to 0.5m long. The basal rock is poorly sorted as it contains clast only a few mm long as well as the large clasts but is clast-supported. The clasts show no obvious preferred orientation and vary from rounded to angular. Many to most are angular or subangular. The lowest bedding surface (poorly defined) is about two metres above the base. Within four metres of the base quartz sandstone beds occur. The sandstone is well-sorted, cross bedded and ripple-marked. The sandstone beds in a few places rest on scoured surfaces but more commonly the beds are parallel-sided and laterally persistent over ten metres or more. The few current structures measured suggest currents from the west, south-west and south. The conglomerate succession on both the first point and the second point south of West Point is very reminiscent of the succession on Albatross Island but the sandstone beds are more common and more laterally persistent. The conglomerate south of West Point is regarded by Dr. D. Seymour (pers. comm.) as stratigraphically equivalent to the Upper Proterozioc Forest Conglomerate from the other side of the Smithton basin but rests on a shallow water carbonate seqence not on a pyritic siltstone like the Cowrie Siltstone. It is interesting to note that both conglomerates, that on Albatross Island and that south of West Point, can be inferred to be proximal on the basis of the size, sorting and angularity of the component clasts. The higher conglomerate to sandstone ratio and to lesser lateral persistence of sandstone beds suggests that the conglomerate on Albatross Island is the more proximal of the two. Both conglomerates seem to be derived from the southwest and from terrames of somewhat similar geology but they cannot be derived from the same source.

In the Esso Clam 1 well, the drill cut for 190m through non-porous conglomerate and massive red siltstone, the conglomerate containing clasts from pebble to cobble grade of varicoloured siltstone. In that hole the red rocks lie beneath the Upper Cretaceous Waarre Formation and rest on hard grey shaley siltstone (48m of core), which rests in turn on low-grade Precambrian phyllite (Lunt 1969). Lunt (ibid) regarded the red rocks as probably Upper Devonian to Lower Carboniferous probably by analogy with the rocks of the Grampian Mountains of Victoria, now regarded as Early Devonian (Turner 1986). The Esso hole was drilled on the eastern flank of an old basement "high". West Point is about 68km, more-or-less along strike from Albatross Island, Esso Clam 1 about 134 km across strike from the Island. Still further away are the siliceous conglomerates and sandstones of the Upper Cambrian to Lower Ordovician Denison Group, e.g. at Moorey Mt. (145km), Mt. Pearce (143 km), Duck Creek (153km) and Zeehan (176km). The presence of haematite clasts in the sandstone is reminiscent of the situation in the Dial Group (Lower Ordovician) near Ulverstone 150km to the east-southeast (Burns 1964:67). On balance the most likely correlation is with the conglomerate south of West Point which is probably Upper Proterozoic.

STRUCTURE

Throughout the island the beds dip west-north-west ((Plate 1A, 1D). In the two northern sections the dip is constant at about 35° but decreases to about 20° in the next section south and is shallower still in the southermost, 10° to 12° as measured by sighting along strike from 100 to 200m. The strike varies a few degrees around 30°.

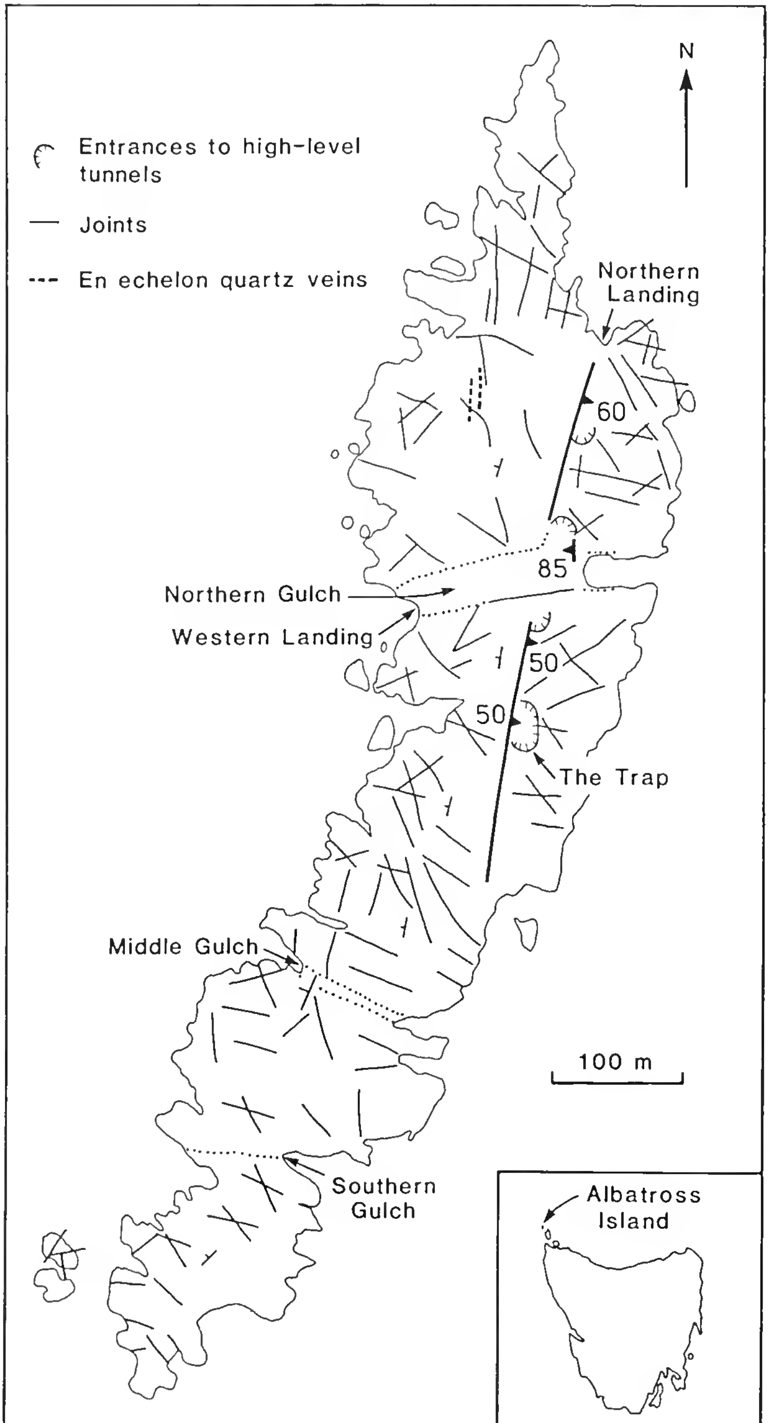

Figure 1: Map of Albatross Island showing some geological features. Orientation approximate.

Structures have controlled the presence and course of a high sea-level tunnel which is close to meridional. The western wall of the tunnel is defined by a breccia zone up to about 0.4m thick dipping to 95° at 60° (at northern end of north tunnel), 90° at 50° at the northern end of the central tunnel (Plate 1F), 100° at 50° at the southern end of the central tunnel. The eastern wall is controlled by a shatter zone about 0.5m wide dipping 255° at 85° (northern end of north tunnel) and vertical or dipping steeply west and trending close to 360° at the northern end of the central tunnel (Plate 1A).

The island is divided into four sections by transverse gulches (Plate 1A). The northermost gulch trends about 80°, the central about 120° the southernmost about 95° These presumably follow major shears; the central one certainly does and the shears which produced it dip very steeply north-east. In addition to these major features jointing is very prominent and seems to be more closely spaced in the two southern sections.

Joints representative of the jointing at various places are shown on the map. All sections show a concentration of joint trends just north of west (285°) and about 330°, this latter direction being particularly prominent in the southern section. Joints trending just north of east (85°) occur in all sections but are especially prominent in the southern section and rare in the northern. The northern and northern middle sections also show concentrations just east of north (20°) and at about 50°, directions poorly or not represented in the southern middle and southern sections. The four sections differ in joint intensity and direction, and to some extent in dip, and may be seen as separate structural sub-domains. The northern and northern middle sections were, however, both affected by the fault that subsequently controlled the formation of the high-level sea tunnel.

Veins of quartz cutting the rock are rare. Several were seen in sandstone beds and in only one place — in the northern section — was seen a system of en echelon gash veins. These trended north, dipped east at about 50° and stepped en echelon to 25°.

Sutherland (1973) noted that Hunter Island to the east is a meridionally elongate dome in Precambrian rocks broken by mainly meridional faults and intruded by dolerite dykes. Albatross Island could well be part of the same structural domain. Rare cobbles of green, somewhat metamorphosed mafic rocks in the northern gulch may indicate the presence of Precambrian dolerite close off-shore.

GEOMORPHOLOGY

As Albatross Island is approached by boat from the east, the first impression of a flat top in the northern part of the island and of a jagged profile to the south. The jagged profile reflects the intensity of jointing in the south and the deep erosion along the joints. The apparent flat top in the northern part (actually the northern and northern middle sections) stands at close to 38m ASL and is restricted to the eastern half of the island. Within the flat area are low strike ridges, scarps to the east, dip slopes to the west. Narrow, elongate, shallow depressions lie above the tunnels, which will be described shortly. The eastern margin of the flattish area is a steep sea cliff. West of the flattish area the topography is dominated by steep, fairly low east-facing cliffs and long dip slopes terminating in low steep cliffs. The western coast has a much more jagged outline than the eastern, largely due to irregular erosion along joints and the abundance of fallen blocks of conglomerate close to shore. A couple of islets occur off the east coast, many off the western.

As noted earlier, three main gulches cut across the island, probably largely eroded by the sea at higher sea levels. The only depositional features occur in these gulches, the northern one being floored by cobbles, the middle one by cobbles at its western end.

The salient geomorphological feature of Albatross Island is the line of high level tunnels traversing the northern and northern middle sections of the island. These are almost meridional in strike, noticeably straight and with roofs that dip gently east and walls which dip steeply west in general but are all irregular in detail. The Trap, in the northern middle section, is a portion of the tunnel in which the roof has colapsed. The tunnel roofs are variable in height,

that of the northern tunnel being at about 23m ASL, of the middle tunnel at about 19m ASL. The floors are probably about 18m ASL (northern) and 17m ASL (middle) but in neither case are the exposed floors the original floors of the tunnels.

The tunnels are likely to be part of a sea tunnel driven from the north along zones of structural weakness at a sea-level of the order of 20m above present. Sea penetration from the north is suggested by the relative heights of the roofs, there being a consistent fall from north to south.

Albatross Island lies on a northeasterly trending submarine bank which rises from depths of about 60m to a flattish platform at a depth of about 40m. The island rises steeply from 30m below sea-level, the 30m contour being only 250 to 300m offshore, except in the south where a platform at 4m occurs. It is interesting to note that the eastern margin of this platform is approximately collinear with the fault which controls the position of the high level sea tunnels. Further, the line of the southern gulch is approximately collinear with a straight portion in the 50m isobath east of the island. Except for these two collinearities the island and its structures stand athwart the trend of the submarine bank.

The flattish top at 38m ASL suggests a high sea-level stand, also invoked by Jennings (1959:27) for deposits on King Island at 120 to 150 feet (36 to 45m) above sea-level. The high-level tunnel caves at about 20m ASL are reminiscent of similar caves on King Island (Jennings 1959, Goede 1979) on Hunter Island (Bowdler 1974) and at Rocky Cape (Gill & Banks 1956) Bowden & Colhoun (1984:327) noted a sea-level stand about 32m ASL, albeit only a brief one with a later, more prolonged stand at 21 to 22m. If this identification is correct, the planation occurred between 120 and 130 thousand years ago (Bowden & Colhoun 1984:331; Colhoun 1975) and the erosion of the tunnel 100 thousand years ago or somewhat less. The caves are likely to be pre-Last Glacial (i.e. older than 75,000 years) because a deposit of angular scree occurs within the northern cave beneath more modern deposits (S. Brown, archaeological dig). A Last Interglacial age for the plantation and cave formation seems very likely.

Soils on the island are shallow and sandy, mainly developed in parts of the flattish area.

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